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Scaling Laws for CMI-induced radio emission

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Abstract

Radio emission driven by the electron cyclotron maser instability (CMI) is a common feature of all large-scale planetary magnetospheres, and even certain active stars. However, the detailed properties of CMI-induced radiation differs widely among the planets depending on the local environment (magnetic field strength, electron density, energy spectrum and velocity distribution, the presence of solitary structures, and the nature of the density cavities in the acceleration region. These varied radiation properties include intensities, frequency fine structure, polarization, and angular beaming. These observed radiation properties depend scale with characteristic dimensional parameters. Figure 1 illustrates one aspect of this scaling, viz., the dependence of RX mode cutoff frequency with the electron cyclotron frequency and mean energy. As the electron energy increases, the cutoff frequency and allowed range of plasma to cyclotron frequency dramatically increases. I will discuss the general problem of how these dimensionless ratios scale with planetary and stellar parameters, possibly explaining e.g. the differing polarization properties of Kronian SKR compared with terrestrial AKR and the possible radiation properties of extrasolar planets with much larger magnetic fields.

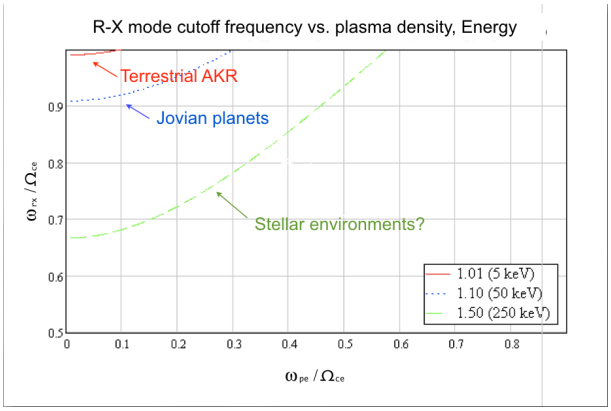

Figure 1: Normalized R-X mode cutoff frequency vs. the electron plasma to cyclotron frequency for CMI-indiced radiation.